PAG compressor oils such as ullair Sullube 32 and Ingersol-Rand SSRS Ultra Coolant

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Waleed Mohamed Brilliant comments. 2030A can fit also for turbine applications by specific dosages and we will get what we called HTC(hydraulic, turbine, and compressor) multiservice oil in associate with PAOs stock.

muzaffar hussain If you wish to make synthetic compressor oil then I suggest you to switch to BASF irgacore, which have better compatabilty and desired properties unlike other additives supplied by Big 4.
Denisa Ivana I used Irgacor 832 as an Aw and antirust in synthetics , very effective .....and in a very low conc. The effectivenes of the additives is not always better at higher rates.

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Screw type oil flooded air compressors. Common oil change intervals?

We follow up many screw type oil flooded compressors (with air-oil separator) by oil analysis.

Well know OEMs usually recommend an oil change after 4000 hours if a mineral oil is used and 8000 hours if a synthetic one is used. It is also usually recommended to change oil filter and separator at 8000 hours.

The problem is that when we analyse the used oil, data indicate that an oil change should take place, in much shorter times. Even half of what the OEM recommended.

Usually the TAN is increased, viscosity is increased, there is some moderate water contamination, additive concentration have greatly reduced. All these indicate that an oil change must take place.

If this is the case, why OEMs continue to give the same recommendations regarding oil change intervals? Have you similar experiences?

We have this phenomenon, with some Atlas Copco GA compressors, Kaeser and Ingersoll Rand.

What we currently do, is that if there is an increase by one ISO viscosity grade in oil's viscosity, or increased ISO cleanliness (contamination), or any kind of wear, we recommend an oil change.

With mineral oils this happens after 2000-3000 hours and with PAO after 5000-6000 hours.

Nurudin Jamil

Yes, it is common for flooded screw compressor.
When the oil is injected to lubricate the screw, at that time the oil has to face the compressed air (Containing O2 and H2O), at high temperature. The oil is oxidized.
The indication is increase in viscosity, TAN and the colour become dark.

For water, it depend on the air humidity in your area.

Do you have any PDI transmitter in the oil filter and oil separator as well?
If yes, the trending analysis of the increasing rate in the PDI may tell you better.

Jean-Michel Demaret

Often OEM like Atlas Copco or Ingersoll Rand sell their own brand of oil. They are the only oils which are approved for the 8000 hours (1 year). Any other brands are not approved. The OEM sells as well extended warranty in the form of servicing (OEM or authorised dealer). The compressor is

serviced by the OEM and use OEM oil, if something goes wrong, the user has only one finger to point. peace of mind for the user. At 40 000 hours there is likely to be an overall, when many parts will be changed. The compressor needs only to last 5 years. It is less important if the oil is not 100% fit or there is a bit more wear than it should be.

Contamination: as the air is in contact with the oil you would expect some contamination even with the best air and oil filtration
Water: generally in under-loaded compressor (stand-by), some OEM oil (IR) can absorb % of water

Metal: The drive is done by contact of one screw on the other you can expect some iron, however the volume of oil is large for a flooded compressor.
Follow the trend at 6000 hours there is 3x more wear than at 2000 hours.

Muhammad Hassan Abbasi

Screw compressors operating at around and above 100 degree Centigrade, tend to reduce oil life by half, as per OEM manual.
Every screw compressor behaves differently, which can not be generalized. So condition monitoring at 2k, 3k and on wards in a must.

SHIH KAI LUM

Whatever the OEM had recommended, they are all tested and are achievable. However, these tests may be done in an ideal condition and environment that may not be the same as how the actual user operates the compressor. Moreover, one of common mistakes is also the position of the air intake position of the compressor. As such, these may be the reasons why the recommended oil is not able to reach the suggested operating hours.
We have to keep in mind that most air cool screw compressor are designed to operate at temperature between range of 80-90 deg Celsius. At this temperature, mineral oil will definitely not last 4000hrs.
For Atlas Copco screw, mineral oil may be recommended. But what we've experience here is that this is not your Gp 1 type mineral oil. They are mostly Gp2 (plus) and able to last 4000-6000 hrs.
For IR, using any oil other than PAG/POE will result in higher operating temperature and of course lower operating hrs.
In all our experience, especially in Asia, following the OEM recommended oil will work. However, it may not be the most suitable depending on the operating condition and environment.

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PINAKI ROY Advisor at uranium corporation of india ltd

It is well known that when the oil separator (whose function is to separate the oil from the compressed air) gets too dirty, it does not function properly and this improper separation results in the oil leaving the compressor along-with the compressed air (oil carry-over). This creates a pressure difference with the internal pressure of the compressor being higher than the discharge pressure causing high discharge temperatures. This in turn causes oil carry-over to increase and pollute the air drier beds causing reduced system efficiency.
While as a thumb rule oil separators should normally be replaced every 8000 running hours or once a year when running 24/7, the use of specially formulated for high performance synthetic oils may help in longer oil & separator life. But as explained above actual advantage can only be accrued provided factors like pressure differentials & temperature are kept under control. If not then the advantage of these high cost oils become ineffective.

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Gongde Liu Lube R&D Dept. Manager at PetroChina Dalian Lube R&D Institute

In gas pipeline or storage field, gas engine powered compressors (e.g. Cat G3608/Ariel JGC-4 sets...) are widely used.

For pipeline transportation, the max. discharge pressure is usually lower than 10 MPa (often several MPa), and the cylinder and crankcase and the gas engine are lubricated with the same oil (generally SAE 40 low ash gas engine oil).

For gas storage underground field, the compressor discharge pressure is about , the cylinder lubricants are generally ISO 320/460 mineral cylinder lubricants or ISO 150/220 PAG type synthetic lubricants. In such case, the cylinder oil is different from that of the crankcase and the gas engine. In case of high heavy hydrocarbon content gas compressing, PAG type cylinder lubricants are highly preferred.

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Arrad: does **Air Compressor Lube have any specific recommended base oil**? I ever heard in one discussion that PAG and POE are best, and how about ester? Is it recommended also?

Petr Vavruch Consultant Top Contributor

In most air compressor applications, synthetic oil is justified. Of course, I exclude small garage compressors and compressors where the oil just lubricates bearings and gears and is not in contact with compressed air.
Di-ester is the best for lubricating pistons in big reciprocating compressors.
PAO and PAG are the best for oil-flooded screw compressors - don't believe people who tell you that Group III oils are the same.

Jorge Villafuerte

HEAD LABORATORY

Dear Arrad, please check it blog
http://forums.noria.com/eve/forums/a/tpc/f/826604995/m/8531060912

Jean-Michel Demaret Technical Expert , Concentrating Mill Maintenance at PT Freeport
Very similar to Petr comments
You want to avoid any deposit/ varnish on the piston, bearings and valves. It is important that the lubricant has an exceptional resistance to oxidation
Reciprocating / pistons under 7 bars/100 PSI : Good Mineral, Di-ester or PAO
Multi stage reciprocating 7 bars and over : Di-ester
Oil free screw compressor : Good mineral or PAO
Oil injected screw conveyor : PAG with a higher density (higher calorific value) can cool the air better , PAO can do a good job as well
Vane compressor PAO or good mineral with excellent oxidation resistance
Axial flow and centrifugal compressor: PAO

Sean Kovanda Sales engineer at American Chemical Technologies, Inc.

It is a fairly simple discussion. What performance and life are you looking to get out of your compressor? There are a variety of lines of oil that you can use for cheap and will work for a while, but will create the by products like sludge and varnish that lead to degradation of your equipment. The beauty of PAGs that has made them the choice for high quality fluids put into compressors by the ingersoll rands and sullair is their resistance to varnish. PAGs are incapable of creating insoluble varnish! In a tight system like compressors, none varnishing fluid is highly valued and gives you the 12,000 hr performance that other oils can't provide. But it's pricier upfront but will save you a lot of money in the end. If you'd like more information email me at smkovanda@americanchemtech.com and I can send you technical bulletins and case studies to back up what I stated above. We at ACT have been the producer for all of sullair compressor fluids for years and they can back us also.

Fernando Oscar Bilotti Senior Field Engineer Support - Argentina Area -Minería y Marine & Aviation Lubricants en Axion Energy S.R.L.
In my experience, for screw air compressors, the best option is the PAO based product like Mobil

Rarus SHC 1020 series with very good results in differents brands of compressors. I prefer the PAO instead of PAG's due to the problems with air with presence of H2O. If the compressor is alternative, the best option is Diester like Mobil Rarus 800 Series with very high performance in several compressor with mor than 5 times the ODI compared to Mineral Oils and not carbon deposit in valves which can conduce to explosion in some applications. You need to evaluate the cost and benefits in terms of productivity, safety and environment (redus waste oil disposal).

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João Pedro Peres If a screw compressor OEM recomends an ester base lubricant, could I use a PAO base lubricant? What is to be careful in this aplication?

John Neale Director at John Neale Ltd

I would guess the lubrication could be an issue. Esters have very good lubrication performance. These types of products are readily available so I can see no reason to use PAO.

Ali Durrani Management, Sales, Marketing, Branding, Lubricants and Lubrication, and Maitenance

It seems the compressor has high performance requirement on oxidation, thermal stability, varnish protection etc. I would not use PAO's is it, is it a screw compressors? Although PAO are very good products but in case of compressors and jet engines PAO's are not the most suitable products.

Rüdiger Krethe expert and certified trainer in lubrication and oil analysis

Two main facts have to be considered first:

1. What kind of gas has to be compressed?
2. Is the compressor chamber oil flooded or not?

Without this Information you can run in serious trouble when changing from an ester to PAO. Often gas or refrigeration compressors use ester based fluids due to their polarity. That means to get a solubility with the compressed gas (or not).
Often people have only air compressors in their mind when talking about compressors. But there exist a lot of other gases in the world have to be compressed too.

Oscar Tonatiuh Ramirez Castillo Sales specialist looking for an oportunitty.

With all the information in hand it could be easy to help you telling is PAO can replace Esther base oil lubricant.
But I am pretty sure the answer will be no, please don't change it.
You could try different brands (properly advised) but keep the base oil, there is always a good reason before that OEM recommendation, no mention Warranty issues).

Sam Kennedy Market Manager - Gas Compressor Lubricants at Summit Indust Products

Assuming it is an oil flooded screw, the answer depends on the gas being compressed, the discharge pressure, discharge temperature, the type of ester recommended, the viscosity grade recommended and the make/model of compressor. Is this a new machine or has it been using ester for awhile? Are you wanting a pure PAO or is a PAO/ester blend acceptable? PAO is much more common than esters for rotary screws. If the OEM recommended an ester, there may be a reason.

George Abernathy Fluid Product Specialist at Steiner Metalworking & Industrial Supply

I would check the seals-if they are compatible.
In many cases one need to go to a mineral based oil first for a set # of hours, evacuate, and go to whatever oil you decide to use as the additives and other factors may not be compatible. There is always some of the prior oil in your system-unless it is getting rebuilt.

Mile Stojilkovic Director of development lubricants at NIS Gazprom Neft

The basic rule is: You must comply with the recommendations of equipment manufacturers.
A sample of the oil for the compressor depends on the structural solutions of the compressor and the working fluid is compressed. The task of the oil to reduce friction and wear element, to provide a good sealing of the compressor space, and a good separation of the inertia in comparison to the working fluid.
Synthetic Compressor Oils:
Polyglycols
Compressor oils based on polyglycols are characterized by good wear protection and resistance to high pressures. Apply a compressor to compress the process gases such as ethane, propane or butane. These gases do not dissolve in the polyglycol.
Polyalphaolefin
Compressor oils based Polyalphaolefin have high oxidation stability, high viscosity index (VI = 150), and to decompose leave coke residue. They are used in food and pharmaceutical industries.
Esters of dicarboxylic acids
Compressor oils based on esters of dicarboxylic acids are characterized by high thermal stability and high viscosity index. These oils have a very long service life (more than 10,000 operating hours) compared to mineral type VDL (up to 1400 working hours).
Esters of phosphoric acid
Compressor oils based on esters of phosphoric acid are characterized by high thermal stability and longevity (7,000 working hours). They are used as flame-retardant oil in industries where high end temperature of compressed air.

Larry Hajek senior lubricant technical manager at Citgo
PAO is a Very clear family of lubricants but ester covers such a wide range including the diesters, Polyolesters, phosphate esters, biodegradable synthetic esters, and even esters of vegetable oils.

ENG. IVAN RUPCIC Engenheiro de Vendas Técnicas

Diesters are strong solvents. Diesters will dissolve paint and varnish (no varnish), cause certain common elastomers to swell and deteriorate and can damage some common downstream components of compressed air distribution systems. Esters can react with water to form corrosive acids and volatile alcohols.If you are pumping air (ok), at 7 or 8 bar, no problem to use PAO but be carefull with a good flushing and priority to use a good mPAO.

Gongde Liu Lube R&D Dept. Manager at PetroChina Dalian Lube R&D Institute

If said is air compressor oil, the Ester type and the PAO type are generally exchangeable each other, and it's hard to say which type is good, it depends on the base structure and the formula technology. Take Ester type compressor oil for example, a lot of ester could be used as the base stock,e.g.

Adipate ester, phthalate ester, trimellitate ester and neopolyol ester, which affect the finish products' performance a lot. And formula technology is also a key factor.
Though Ester and PAO are compatible, but the additives used in them might not be compatible, thus compatibility tests are necessary, if they are compatible(clean and clear after mixing, no precipitate,no deterioration in water-separation and anti-foam...), Even flushing is no necessary. If there were some compatibility issues, draining out the original oil and flushing 1 or 2 times are necessary before a new one is added.
As Ramesh mentioned above, in most cases, PAO is accompanied with Ester to be used as lubricants base stocks.

Schalk Bruwer Owner at Advnce Fluid Performance Ltd

A single issue that needs attention is seal compatibility. Seals used in a compressor for which an ester based lubricant is recommended will have certain swell/shrink characteristics. Seals in contact with esters tend to absorb hydrocarbons making them to swell. The sam seals in contact with PAO

tend to release hydrocarbons and they tend to shrink. As such it is a known principle to use a small amount of ester in a PAO based lubricant to counter the shrinking effect. Shrinking seals will cause leakages.

Can a PAO or polyester based lubricant replace the coolant properties of polyglycol for an air compressor?

Ross Kovanda

Owner/Vice President at American Chemical Technologies, Inc.

We need to know the configuration of the seal materials. PAG's are used throughout the Compressor Market based on their ability to handle the temperatures, and not create any sludges or varnishes during the fluids life cycle. These PAG based fluids provide the highest performance and long term capabilities as compared to PAO's or other fluid formulations. That is why companies like Sullair and Ingersoll Rand have embraced this chemistry as their highest performing OEM Fill fluid.

Ross Kovanda

Owner/Vice President at American Chemical Technologies, Inc.

It is the fluids ability to pull heat away and act as a coolant in the process. Fluids with good thermal characteristics will transfer heat better and faster than others. Some fluids with High Viscosity Indexes allow the end user to drop viscosity grade(s) and still be the same viscosity at the operating temperature. The lower the viscosity, the better it removes the heat away.

Larry Ludwig, CLS, OMA, CMFS

Chief Chemist/Technical Director at Schaeffer Mfg

A compressor that had previously used a PAG based fluid can be converted over to a PAO based compressor fluid if the proper steps and care are taken. Generally PAG or PAG/Polyol Ester blends are not compatible with other type of synthetic base fluids, such as polyalphaolefin (PAO) based compressor fluids. When synthetic based compressor fluids are mixed with a PAG or PAG/Polyol Ester blends the possibility of gelling of the products can occur.

Because of this possibility it is recommends that if a compressor application is being changed over from a PAG, or PAG/Polyol Ester blend compressor fluid to a PAO Synthetic Compressor Fluid that the following procedure be strictly followed:

1. Drain the compressor as completely as possible. Disconnect the air and fluid lines as completely as possible. Remove all oil filters and air/oil separators. Wipe out the air/oil separator bowl with a clean rag to remove any fluid residue.
2. Reconnect the lines and replace all the oil filters and air/oil separators with new elements. Charge the compressor with an either an inexpensive compressor fluid or the PAO Synthetic Compressor Fluid in the proper ISO Viscosity Grade. Run the compressor for 1-hour only.
3. Drain the compressor as completely as possible. Disconnect the air and fluid lines as completely as possible. Remove all oil filters and air/oil separators. Wipe out the air/oil separator bowl with a clean rag to remove any fluid residue.

4. Reconnect the lines and replace all the oil filters and air/oil separators with new elements. Charge the compressor with an either an inexpensive or the PAO Synthetic Compressor Fluid in the proper ISO Viscosity Grade. Run the compressor for 1-hour only.
5. Repeat Step 3 for two or three times.

6. With the oil drain plug removed, begin filling the compressor slowly with the PAO Synthetic Compressor Fluid in the appropriate ISO Viscosity Grade. Allow the new fluid to push any remaining fluid out of the compressor. When new oil is seen, replace the drain plug and fill the compressor.
7. Start the compressor and top off the oil level.
8. Take an oil sample at the normal drain interval or maintenance interval that is specified by the compressor manufacturer or that has been previously established.

Larry Ludwig

The fluid should also be closely monitored for foaming whenever Schaeffer Mfg's compressor fluids are replacing another product. Foaming may be caused by extraneous materials that are either the direct result from previous lubricants or contamination. These extraneous materials or contamination can be existing deposits, mixing of fluids to top off the compressor, water, or some type of solvent that was used to clean the compressor before change out. Therefore, it is Schaeffer Mfg's primary recommendation if foaming occurs that the compressor is drained as completely as possible and new Schaeffer compressor fluid is installed.

Larry Ludwig, CLS, OMA, CMFS

Chief Chemist/Technical Director at Schaeffer Mfg

Regarding the use the oil analysis in order to provide data which can be used to monitor the condition of the compressor fluid and to possibly predict potential problems it is recommended the following sample schedule during the changeover process.

1. Sample the previously used compressor fluid during the drain process. This will provide data to identify its additive chemistry and other chemical and physical characteristics.
2. After filling the compressor with the proper viscosity grade of the **PAO Synthetic Compressor Fluid** sample after a day of operation. The data from this sample will provide a basis for estimating the degree of mixing with the previously used product and the presence of any other contaminants. Also when sampling be sure to send to the laboratory that is doing the used oil analysis an unused sample of either of the PAO Synthetic Compressor Fluid so that they can have a baseline to work from.
3. The next samplings should be taken as indicated in the specific changeover procedures.

The oil analysis program that is used should at a minimum do the following recommended tests:

1. Viscosity @ 40°C
2. Spectrochemical Analysis
3. Total Acid Number
4. % Water by Karl Fischer
5. Antioxidant levels by Ruler Method
6 Varnish Potential by Micro Patch Colorumetry

The fluid should also be closely monitored for foaming whenever Schaeffer Mfg's compressor fluids are replacing another product. Foaming may be caused by extraneous materials that are either the direct result from previous lubricants or contamination. These extraneous materials or contamination can be existing deposits, mixing of fluids to top off the compressor, water, or some type of solvent that was used to clean the compressor before change out. Therefore, it is Schaeffer Mfg's primary recommendation if foaming occurs that

the compressor is drained as completely as possible and new Schaeffer compressor fluid is installed.

Will Hurley

Owner / President - Fluid Metrics LLC

There are several questions being asked here, but the obvious question I would ask is why would you ever consider replacing a Polyglycol (PAG) compressor fluid with a PAO? This move would be a major step backward since today's PAG/POE blends are demonstrably superior to PAOs in air compressor applications with specific regard to oxidation stability, hydrolytic stability, varnish potential, thermal conductivity, viscosity index, flash point, oil carryover, and service life. The gap in performance benefits of PAGs over PAOs in air compressor applications grows even wider if you're comparing PAGs to lesser base stocks such as diesters and mineral oils. As suggested earlier, the PAG's many proven benefits explain why the majority of rotary screw air compressor OEMs have now standardized on PAG/POE blends as their factory fill.

Given this information, the more logical question would be how to convert a PAO filled compressor to a PAG/POE blend? The best advice for this is to perform a thorough drain of the PAO, followed by a half-charge flush with the new PAG/POE fluid, then a thorough drain of the flush fluid, replace oil filters and air-oil separators, and complete with the final fill of PAG/POE. The key here are the thorough drains, as significant volumes of oil can be left behind if only the compressors' sump tank is drained. After the compressor is converted to the PAG/POE, take an initial baseline oil sample for analysis and repeat sampling at 1,000 hour intervals for the next 4,000 hours before resuming standard 2,000 hour sampling. The reasons for the baseline and 1,000 hour analysis are to: 1) Confirm the drain and flush conversion was effective and that there is minimal residual contamination from the previous PAO fill. And, 2) Closely monitor the new fluid's TAN and viscosity for the first 4,000 hours since the new PAG/POE will dissolve (clean) any residual varnish left behind from the PAO. In many cases, depending on the severity of the varnish left behind from the PAO, the initial fill of PAG/POE will not reach its full rated service life (8,000 hours) due to the acidic contaminants (varnish) that are being removed from compressor internals by the new fluid. This is a short-term issue, however, that will improve over time as the varnish is removed and compressor internals are restored to their new, varnish-free, condition. After converting to the PAG/POE, you should notice as much as a 10 deg. F decrease in compressor operating temperature due to the higher thermal conductivity and cleaner internal heat transfer surfaces in the oil cooler.

Richard Widman

Owner, Widman International SRL

From what I've seen, the reason to move away from PAG is that it is not readily available. Here many compressors are imported directly, and even the major distributors frequently don't have the oils specified due to high import restrictions and regulations. When they do have them, they charge significantly for them. Most just buy a readily available R&O oil in drums and package it in 20 lt jugs at 4 times what they paid.

As far as oil life, due to ingrained belief of 90% of the population that air filters should be cleaned weekly or more often with high pressure compressed air, most fluids are changed on contamination rather than degradation.

A few learn, sometimes when it is explained that the reason they have to pay $400 for a new air/oil separator so often is that they are "cleaning" their intake filters instead of changing them.

Jean-Michel Demaret

Qualified Engineer / Senior Account Manager

Oscar, generally PAG oils are recommended by the compressor manufacturer for screw compressor with oil injection. These compressors are able to reach higher pressure than oil free screw compressors, so likely they will generate more heat. I believe from different studies that because of their higher density PAG oils have a higher Specific Heat Capacity (can absorb more heat per weight for a set increase of temperature) than PAO. It is a 10-20 percent order of magnitude. As per the heat transfer coefficient (absorption and release of heat by conduction or convection) depending on the website one is better than the other. For same volume of oil injected, the PAG is possibly able to cool better/provide a better seal than PAO. If your oil injected screw air compressor is operating at the limit of its capacity, a change of oil characteristic may add issues to the maintenance department.

John Neale

Director at John Neale Ltd

PAG is a very good lubricant for compressors, it has excellent lubrication, thermal and oxidative stability and it does not produce lacquers or deposits when it degrades.
For auto-motive compressor oils and other very high performance applications di-capped PAG's are used which offer enhanced thermal performance, and also they are less hygroscopic.

Schalk Bruwer

Lubricant Engineer at Orica NZ
PAGs tend to be polar by nature. That is why you will find that they mix with water -- brake fluids and water-glycol fire resistant hydraulic fluid are prominent examples. Also you will find that PAGs normally do not mix with "oils". In refrigeration compressors they are used when R134a or HFC blends are used as refrigerants. PAGs (and polyolesters) mix readily with these refrigerants and especially at low evaporator temperatures the lube (PAG) is still carried through the refrigeration side preventing line blockages due to "oil" left behind in evaporator.
In the compression of hydrocarbon gasses the use of mineral type oils as compressor lubricants have the issue that they are picked up by the compressed gas and removed from the compressor which is eventually starved from lubricant. As such PAGs are used with great benefit in the compression of hydrocarbon gasses.
But saying that Dow Chemicals supply a great range of "oil soluble” PAGs.

Vibhushit Dave

Proprietor at Hymat Services

PAG is also used extensively in defence applications like submarines & subsea applicatios like off shore platforms.

Ross Kovanda

Owner/Vice President at American Chemical Technologies, Inc.

They can be kept dry with desiccant breathers, air blankets or depending on which type of PAG is in use, vacuum dehydration works very well! The other critical aspect is that even with water in the fluid, it does not chemically change the backbone of the formulation like other fluid chemistries. PAG's are the most forgiving fluid available for industrial applications!

Alexey Muralev

Head of Technical Service Department at Kulan Oil

PAGs are good for containing some water without doing damage to equipment. But there are still incompatibility issues with some paints and seals. So in order to use PAG instead of mineral oil the equipment should be made compatible with PAG. Plus the price.

I see a lot of natural gas compressors (reciprocating) that use PAGs, including Ariel.
As was said above they are very resistant to oxidation, good deposit control.

Ross Kovanda

Owner/Vice President at American Chemical Technologies, Inc.

We have run testing on PAG Based turbine fluids and FR Fluids in the steel industry! We know that 200 ppm of water in phosphate esters, polyol esters or vegetable esters causes a significant increase in TAN, and in some cases depending on fluid type can cause chemical changes to the base product and cause serious issues! We handle all types of PAG based applications and formulations, they provide significant advantages over other fluid formulations. We have recently been approved under the new GEK specification for synthetic base turbine fluids in their approval! Hope this helps!

Will Hurley

Owner / President - Fluid Metrics LLC

For more than 30 years, PAG synthetic lubricants have been the standard factory fill for many U.S. rotary screw air compressor manufacturers. As mentioned previously, PAGs have excellent oxidative and hydrolytic stability, very high viscosity index, low oil carryover rates, and will not form varnish or other harmful deposits. The PAG's hygroscopic nature allows them to hold a great amount of water in solution, and not form "free water" as is common with PAOs and mineral oils. This property makes PAGs ideally suited for air compressor applications where there is always moisture present, especially in high humidity environments. Today's advanced PAG formulations can provide up to 16,000 hours (2 years) service life in air compressor applications, compared to the outdated 8,000 hour formulations still offered by most compressor OEMs.

normally is 1000 to 2000 hours in mineral hydraulic oils or 8000 to 12000 hours in synthetic hydraulic oils

REFRIGERATION COMPRESSORS

Shell Clavus: naphthenic oil for DIN 51503 KAA, KC and KE

There is a German specification DIN 51503 where alkyl benzene is type KAA and KC and polyol ester type KD, ISO 6743-3:DRD. Naphthenic ISO 6743-3 : DRA, DIN 51 503: KAA, KC, KE, polyol KD, KE pao DIN 51 503-1, Category KAA

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The ammonia reacts with the POE, breaking it to the original organic acid and alcohol. If water is present, the results could be catastrophic.

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Jean-Michel Demaret

John, **Alkyl Benzene and R22 are miscible**, these **waxy deposits** are likely to be throughout the refrigeration system. The AB (Alkyl Benzene) and R22 work well together. Likely culprit could be Insufficient cleanliness of the system after refilling with R22 ((clean up pipes with solvent and 24 hours vacuum), substandard R22 or as Petr mentioned wrong oil in use. Look for poor efficiency of the evaporator (unable to reach the designed temperature). The root cause of the problem will be found in the maintenance history

The compressor is the hottest spot of the refrigeration system. If the compressor overheat and the oil deteriorates (cannot oxidises of course because there is no air), check first the proper operation of the condenser. Ask your customer to check if the pressure at the suction is normal, Very low pressure (restricted flow in evaporator or poor operation of the expansion valve) may create such vacuum that if the oil is a blend of 2 different viscosities the most volatile will separate and be trapped in the refrigerant, while the heavier molecules may linger longer in the sump.Check the viscosity (evaporate the R22 before testing the viscosity) and the TAN.

V.S.S. Sarma

Linear Alkyl Benzene (LAB) is produced in refineries using Linear Alkyl Benzene Feed Stock (LABFS). This process produces raffinates which are like the rejects from the system. These raffinates are known as alkylates and are used as refrigeration compressor oils, as world-wide the stocks of naphthenic oils is coming down and the development of an alternative is imperative. Alkylates have excellent low temperature properties like pour point and floc point but then they are deficient in lubricity. For this, small quantities of lubricity additives and high-performance anti-oxidants are added to alkylates and the resultant product provides outstanding service life. World-famous Suniso oils are basically these alkylates.

By the very nature, alkylates are not supposed to contain any wax. But problem arises when an innocent quality control manager of a production plant wants to reduce the pour point (to impress customer) and hence adds a pour point depressant (PPD) which is basically a polymethacrylate that gels at very low temperatures.

Refrigeration compressor oils should not use any PPD. I suggest that the oil be replaced with another brand that doesn't contain a PPD.

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Veselin Cholakov Lubrication Engineer at Lubes Experts Ltd.
The right recommendation for ammonia compresor are :
1.Mobil Gargoyle Arctic Oil 300 /ISO 68/ -mineral oil for old systems
2.Mobil Gargoyle Arctic SHC NH3 - for old refrigerent systems /replacing of mineral oil.
3.Mobil Gargoyle Arctic SHC 226 E - for the brand new systems.

Mobil EAL Arctic are recommending for CFC , HFC ,HCFC regfrigerents /for ammonia is very specific exception ?! /
Please check the following :
1.OEM recommendation for these type compressors /and refrigerents/ - it may be is wrong recommendation
2.Change the hole quantity of oil .
3.Check the oil pump , releave valve and filter
4.Check wether is has been used seals/elastomers -silicon types
5.Check the qaulity of ammonia and entried air

Don McNeil • Actually the closest direct replacement is Refrigeration Oil S2 FR A 68. Although Clavus 68 is still listed in the Shell Global Product Catalogue.
http://www.epc.shell.com/Docs/GPCDOC_GTDS_Shell_Refrigeration_Oil_S2_FR-A_68_%28en%29_TDS_v1.pdf

A. J. QURESHI:
Shell Refrigeration Oil S2 FR-A (Previous Name: Shell CLAVUS S) is a low miscibility compressor lubricant recommended for use with ammonia (R717) based refrigeration systems where it offers excellent performance, even under high compressor discharge temperatures, or down to evaporation temperatures of -30°C. It is formulated from specially refined paraffinic base oils in combination with additives selected to minimize system deposits and provide long service life.
It can also be used in systems using hydrocarbons such as propane (R290)
Shell Refrigeration Oil S2 FR-A is not recommended for use with CFC, HCFC or HFC refrigerants such as R12, R22 or R134a.
Shell Refrigeration Oil S4 FR-V (Previous Name: Shell CLAVUS AB) is a synthetic refrigeration lubricant based on alkylated benzenes. It offers a universal solution to the lubrication requirements of most refrigeration compressors and is compatible with all commonly used refrigerants with the exception of HFCs.
Shell Refrigeration Oil S4 FR-V is designed for use with most commonly occurring refrigerants:
Ammonia (R717) systems where it offers excellent performance, even under high compressor discharge temperatures or down to evaporation temperatures of -33°C or lower.
Carbon dioxide (R744) systems.
CFC and HCFC systems (R12 and R22)
Hydrocarbon systems such as propane (R290).
Viscosity grade ISO 32, 46, 68, 100,

Schalk Bruwer • If you stick with Shell the product is RO S4 FR V (alkylated benzene) to go with R22 at all evaporator temperatures suited to typical refrigeration applications. If very high evaporator temperatures with R22 I personally believe that the RO S2 FR-A might work but Shell specifically rules out the use of this oil in combination with CFC and HCFC in the prod data sheet. One important (possible) issue is seal material compatibility and if in doubt note the **aniline point** for the replacement oil vs that of the original oil. Oils with lower Ap will tend to swell and those with higher Ap will tend to shrink seals.

Don McNeil • The Shell Clavus series of Refrigeration compressor lubricants is recommended for all types of refrigeration systems such as ammonia, and CFC and RCFC refrigerants such as R-11, R-22, R-500, R-502, R-22, and R-123. The Clavus oils are not recommended for use with HFC refrigerants such as R-134. Shell Refrigeration Oil S4 FR-F 68 is a synthetic polyol ester base fluid that is recommended for use with R-134 and other HFC refrigerants. According to the literature it is not recommended for use with other

refrigerants such as R-22. Shell Refrigeration Oil S4 FR-V 68 is a synthetic refrigeration lubricant based upon alkylated benzenes. It offers a universal solution to the lubrication requirements of most refrigeration compressors and is compatible with all commonly used refrigerants such as R-22 with the exception of HFCs such as R-134. However, S4 FR-V 68 base stock is not compatible with Clavus 68 and if you are switching you need to thoroughly flush the system including lines and pump to prevent compatibility issues.

Don McNeil • I work for a Shell Distributor here in the US and my comments came directly from the Product Data Sheets which are supplied to every customer who buys Shell products. Not sure who told Akbar that Shell S4 FR-F oil replaces Clavus 68 but they were obviously misinformed as shown in my prior note. However, Shell Refrigeration Oil S4 FR-V 68 is an upgraded replacement for the Clavus 68 with the proper notice on compatibility and flushing required. Shell Clavus 68 may not be available in every country of the world as this is the old product for this application. Attached is a link to the Shell Global Product Portal. http://www.epc.shell.com/

V.S.S. Sarma • Heavy alkylates have been used as refrigeration oils over a long period of time. Only problem with them is that they lack lubrication quality which is being compensated by the addition of additives.
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As the need for engine oils that produce lower emissions has increased, the method of processing crude has changed to a hydrogen cracking method from the former solvent cracking method. The result is Group II base oils. **Group II base oils do not separate well from water** and require the use of a vacuum dehydrator to successfully remove all three levels of water contaminates, including the most difficult –dissolved water.

The dehydrator’s vacuum lowers the water vapor pressure inside of a chamber while at the same time, the contaminated oil passes through that chamber. This lowering of the water vapor pressure causes the water to change into the vapor state and be discharged as vapor by the vacuum pump. These systems are plumbed to the oil reservoir in a kidney loop configuration and are useful for applications that have a large volume of water contamination.

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Synthetic oil and synthetic blends

Synthetic lubricants were first synthesized, or man-made, in significant quantities as replacements for mineral lubricants (and fuels) by German scientists in the late 1930s and early 1940s because of their lack of sufficient quantities of crude for their (primarily military) needs. A significant factor in its gain in popularity was the ability of synthetic-based lubricants to remain fluid in the sub-zero temperatures of the Eastern front in wintertime, temperatures which caused petroleum-based lubricants to solidify due to their higher wax content. The use of synthetic lubricants widened through the 1950s and 1960s due to a property at the other end of the temperature spectrum, the ability to lubricate aviation engines at temperatures that caused mineral-based lubricants to break down. In the mid 1970s, synthetic motor oils were formulated and commercially applied for the first time in automotive applications. The same SAE system for designating motor oil viscosity also applies to synthetic oils.

Instead of making motor oil with the conventional petroleum base, "true" synthetic oil base stocks are artificially synthesized. Synthetic oils are derived from either Group III mineral base oils, Group IV, or Group V non-mineral bases. True synthetics include classes of lubricants like synthetic

esters as well as "others" like GTL (Methane Gas-to-Liquid) (Group V) and polyalpha-olefins (Group IV). Higher purity and therefore better property control theoretically means synthetic oil has good mechanical properties at extremes of high and low temperatures. The molecules are made large and "soft" enough to retain good viscosity at higher temperatures, yet branched molecular structures interfere with solidification and therefore allow flow at lower temperatures. Thus, although the viscosity still decreases as temperature increases, these synthetic motor oils have a much improved viscosity index over the traditional petroleum base. Their specially designed properties allow a wider temperature range at higher and lower temperatures and often include a lower pour point. With their improved viscosity index, true synthetic oils need little or no viscosity index improvers, which are the oil components most vulnerable to thermal and mechanical degradation as the oil ages, and thus they do not degrade as quickly as traditional motor oils. However, they still fill up with particulate matter, although at a lower rate compared to conventional oils, and the oil filter still fills and clogs up over time. So, periodic oil and filter changes should still be done with synthetic oil; but some synthetic oil suppliers suggest that the intervals between oil changes can be longer, sometimes as long as 10,000 - 15,000 miles.

With improved efficiency, synthetic lubricants are designed to make wear and tear on gears far less than with petroleum-based lubricants, reduce the incidence of oil oxidation and sludge formation, and allow for "long life" extended drain intervals. Today, synthetic lubricants are available for use in modern automobiles on nearly all lubricated components, potentially with superior performance and longevity as compared to non-synthetic alternatives. Some tests[citation needed] have shown that fully synthetic oil is superior to conventional oil in many respects, providing better engine protection, performance, and better flow in cold starts than petroleum-based motor oil.

Rob:
Industrial synthetics are still seen as key - door openers and make good margin. Energy saving is a focus area.

Compressor oils are difficult because most of the key OEM's sell own brand products and therefore they seldom issue approvals nowadays. Mobil have a good range, but our sales success is limited.

O-Ring Materials Compatible with Di-ester Lubricant MIL-L-7808
(select a material to show its compatible chemicals)

Aflas (0)	Buna-N (Nitrile) (3)	Butyl (1)
Chemraz (4)	Epichlorohydrin (0)	Ethylene-Propylene (1)
Fluorocarbon (4)	Fluorosilicone (4)	Hypalon (1)
Kalrez (0)	Natural Rubber (1)	Neoprene (1)
Nitrile, Hydrogenated (3)	Polyacrylate (3)	Polysulfide (3)
Polyurethane, Cast (0)	Polyurethane, Millable (1)	Silicone (1)
Styrene Butadiene (1)	Teflon, Virgin (4)	Vamac (0)

O-Ring Materials Compatible with Pyrogard 42, 43, 53, 55 (Phosphate Ester)
(select a material to show its compatible chemicals) Aflas (0) Buna-N (Nitrile) (1) Butyl (4) Chemraz (4) Epichlorohydrin (0) Ethylene-Propylene (4) Fluorocarbon (4) Fluorosilicone (1) Hypalon (1) Kalrez (0) Natural Rubber (1) Neoprene (1) Nitrile, Hydrogenated (1) Polyacrylate (1) Polysulfide (1) Polyurethane, Cast (0) Polyurethane, Millable (1) Silicone (1) Styrene Butadiene (1) Teflon, Virgin (4) Vamac (0)

O-Ring Materials Compatible with Transmission Fluid, Type A

(select a material to show its compatible chemicals) Aflas (0) Buna-N (Nitrile) (4) Butyl (1) Chemraz (4) Epichlorohydrin (4) Ethylene-Propylene (1) Fluorocarbon (4) Fluorosilicone (4) Hypalon (3) Kalrez (0) Natural Rubber (1) Neoprene (3) Nitrile, Hydrogenated (4) Polyacrylate (4) Polysulfide (4) Polyurethane, Cast (0) Polyurethane, Millable (4) Silicone (3) Styrene Butadiene (1) Teflon, Virgin (4) Vamac (4)

O-Ring Materials Compatible with Hydraulic Oil, Petroleum Base
(select a material to show its compatible chemicals) Aflas (0) Buna-N (Nitrile) (4) Butyl (0) Chemraz (4) Epichlorohydrin (4) Ethylene-Propylene (1) Fluorocarbon (4) Fluorosilicone (4) Hypalon (3) Kalrez (0) Natural Rubber (1) Neoprene (3) Nitrile, Hydrogenated (4) Polyacrylate (0) Polysulfide (4) Polyurethane, Cast (0) Polyurethane, Millable (0) Silicone (2) Styrene Butadiene (0) Teflon, Virgin (4) Vamac (4)

O-Ring Materials Compatible with Lubricating Oils, Petroleum Base (select a material to show its compatible chemicals)		
Aflas (0)	Buna-N (Nitrile) (4)	Butyl (1)
Chemraz (4)	Epichlorohydrin (4)	Ethylene-Propylene (1)
Fluorocarbon (4)	Fluorosilicone (4)	Hypalon (1)
Kalrez (0)	Natural Rubber (1)	Neoprene (3)
Nitrile, Hydrogenated (1)	Polyacrylate (4)	Polysulfide (2)
Polyurethane, Cast (0)	Polyurethane, Millable (3)	Silicone (0)
Styrene Butadiene (1)	Teflon, Virgin (4)	Vamac (4)

O-Ring Materials Compatible with Turbine Oil (select a material to show its compatible chemicals)		
Aflas (0)	Buna-N (Nitrile) (3)	Butyl (1)
Chemraz (4)	Epichlorohydrin (4)	Ethylene-Propylene (1)
Fluorocarbon (4)	Fluorosilicone (3)	Hypalon (0)
Kalrez (0)	Natural Rubber (1)	Neoprene (3)
Nitrile, Hydrogenated (4)	Polyacrylate (3)	Polysulfide (4)
Polyurethane, Cast (0)	Polyurethane, Millable (4)	Silicone (1)
Styrene Butadiene (1)	Teflon, Virgin (4)	Vamac (4)

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V.S.S. Sarma • Oil cracks after 370 Deg C. Reason why it is distilled under vacuum so that the boiling point is reached much before 370 Deg C.

V.S.S. Sarma • Alkyl Benzenes have good low temperature properties and are bad at high temperatures. They may auto-ignite at low temperatures causing compressor explosion.

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most industrial manufacturers spend less than 2% of their operating maintenance budget on lubric

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